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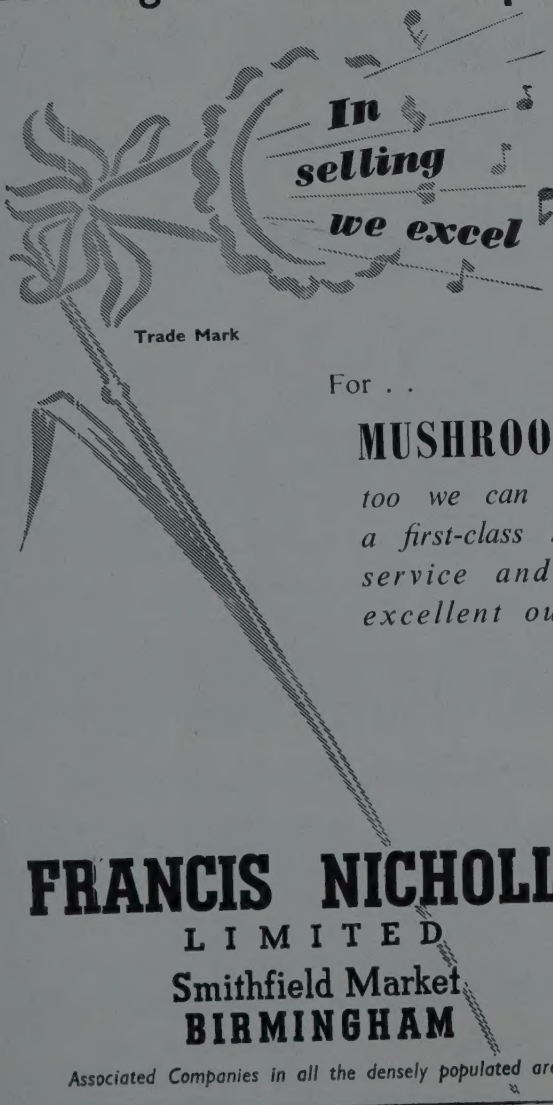

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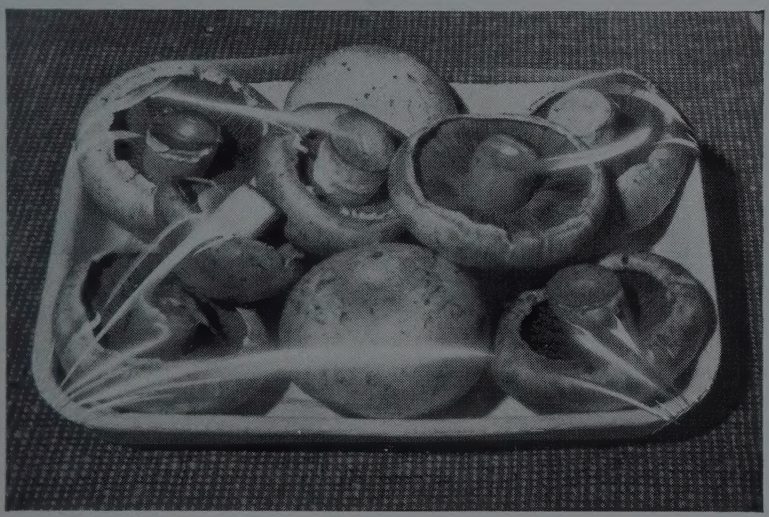

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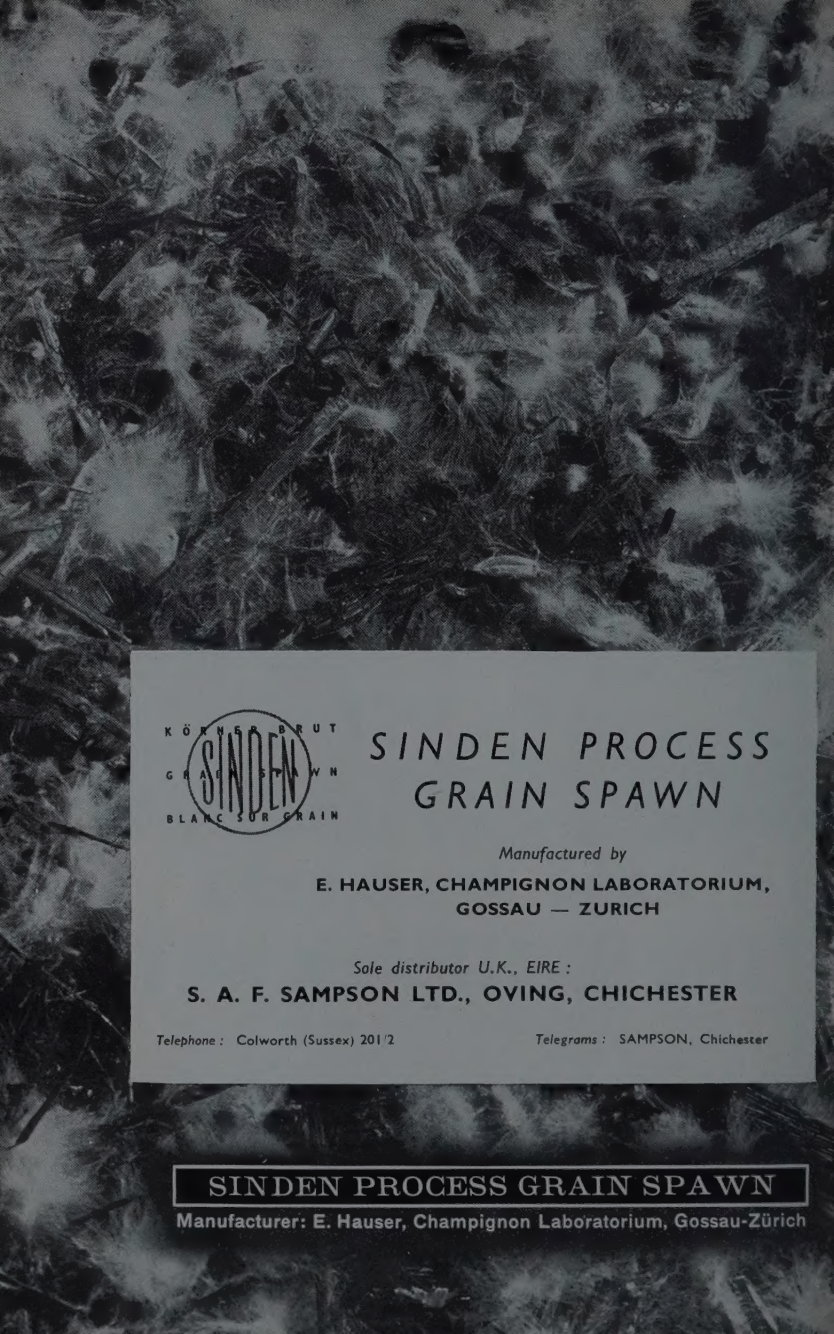

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The
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MARCH - 1958
NUMBER 99

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EDITORIAL

RESPONSIBILITY AND OPPORTUNITY

The Annual General Meeting of the MGA—your " Mushroom Parliament " if you will—is upon us once again and your Executive Committee hope that as many of you as possibly can will spare both the time and the expense to be at the Connaught Rooms, London, on Tuesday, 18th March.

Far too many annual gatherings fail to attract the attention deserved, both from those intimately connected with the organisation concerned and from outside sources whose interest is so often a spur to greater and greater endeavour. Far too often annual occasions adopt a formal and uninteresting mantle, thus encouraging the " leave it to others " attitude, bringing in its wake inertia and stagnation.

There is far, far too much on the mushroom grower's plate at this moment to enable the affairs of the industry to be left to browse in any mid-day sun. Expansion is taking place here, there and everywhere, price returns are falling, young growers are lacking in numbers and good and conscientious workers are getting harder to find. Publicity is on the plate with all its ramifications, its hopes and its fears, an issue not to be avoided.

It is of vital importance then that each and everyone of you should, if possible, attend this annual gathering. This is your Association, this publication your publication. Your governing Committee has every right to expect both your support and your attention, every right to ask you to play your part in the running of the MGA and the direction of the industry as a whole.

Will you be there? You most certainly should.

The purpose of this Editorial is not to spread despondency but to call attention to just a few basic facts—rising costs, falling returns, publicity, to name perhaps the three most vital—and all of you should most certainly do what you can, on 18th March, to give all three a most thorough airing.

WRA

VENTILATION REQUIREMENTS FOR CULTIVATED MUSHROOMS

By EDMUND B. LAMBERT

Pathologist, Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture.

Mushroom mycelium growing in the bed and in casing soil gives off gases that retard or prevent the growth of mushroom caps. The extent of retardation depends on the concentration of the gases. This is apparently nature's mechanism for preventing caps from being formed underground. When the room or chamber used for growing mushrooms is closed the effects of the toxic gases become more and more marked as the period without fresh air is prolonged. The discussion that follows summarizes the principal facts about ventilation as I see them. It is based on a talk given in June, 1957, as part of the programme of the Mushroom Growers' Short Course held at the Pennsylvania College of Agriculture.

Nature of the toxic gases: Abnormalities of mushrooms growing in a confined atmosphere are clearly due to the production and accumulation of toxic gases and not to the depletion of the oxygen of the air inside the compost or surrounding the mushrooms (4, 6). Sufficient quantities of either carbon dioxide or of a certain unknown gas will produce symptoms of toxicity (6). Under practical growing conditions the carbon dioxide of the atmosphere in the house rarely reaches a toxic level and it is probable that the unknown gas is more important as a limiting factor in commercial mushroom growing than carbon dioxide (6). Excessive water vapour in the air may favour the spread of disease producing organisms, but it does not seem to have a toxic effect on mushrooms (6, 7, 10).

If there is between 1% and 2% of carbon dioxide in the air the mushrooms have long stems and small caps. More than 5% of carbon dioxide completely arrests their growth (4).

The unknown gas or complex of gases is absorbed by alkaline permanganate, by mineral oil, and by activated charcoal (6). This gas appears to be an unsaturated hydrocarbon, possibly resembling ethylene gas (6). The level at which it becomes toxic is not known, but it seems quite possible that very minute amounts might produce abnormalities. For example, ethylene gas is known to be toxic to the leaves of green plants when present in the air in concentrations as low as 0·1 part per million.

Symptoms of restricted ventilation: The following are some of the symptoms or signs of restricted ventilation: Mushrooms with long stems and small caps, excessive numbers of small mushrooms on the beds, excessive dying of pinheads, and reduced yield of mushrooms. Small deficiencies or intermittent deficiencies of fresh air may cause poor yields without any other recognizable abnormalities (6). Under some conditions, particularly fluctuating ventilation, mushrooms 5 or 6 times normal size may be formed (5, 6). These mushrooms often have

swollen bases. The symptoms caused by poor ventilation sometimes are identical with those caused by certain other unfavourable growing conditions, and therefore they cannot be used as clear-cut indications of the need for ventilation.

Ventilation during pasteurization: During pasteurization the oxygen in the air must be maintained above 15% (8). This usually can be accomplished by opening the doors for a few minutes two or three times a day. The oxygen of the atmosphere inside the compost in the tray or the bed should be 2% or more (8). If the oxygen content becomes less, the beds sometimes will be favourable for the growth of chaetomium mould after spawning.

Ventilation during spawn run: The rate at which spawn runs in the beds is not visibly affected by a small deficiency in oxygen, but a severe restriction of air slows down spawn growth. This is easily demonstrated with spawn running on sterilized manure in bottles. A moderate restriction of air caused by closing the house during spawn run does not seem to affect the appearance of the spawn and only slightly affects the ultimate yield of mushrooms (5, 6). Also the number or the spacing of the cracks between the bed boards on the bottom of the beds does not seem to be a factor that critically affects the rate of the growth of the mushroom mycelium or the ultimate yield of mushrooms (5).

Ventilation through the casing soil: After the casing is placed on the bed the soil must be kept porous until the mycelium has fully penetrated the casing and begun to form strands. It is easy to demonstrate that the formation of a crust impervious to air over the casing soil immediately after casing will seriously delay the formation of mushrooms and reduce the ultimate yield (3). In practice this is usually prevented by careful watering to avoid the formation of a crust or by heavy watering and drying out of the casing to form a network of cracks. The mushroom mycelium will form strands in the soil in about 10 days or two weeks after casing. Then the beds are much less likely to be injured by shutting out the air by excessive watering. After the first break most soils do not require special care in watering to prevent sealing over since the mushroom strands in the soil and the spaces left by picking seem to maintain sufficient aeration in the soil and in the bed (5).

Ventilation with constant air movement during cropping: When fresh air is constantly introduced into a closed growing chamber at a rate of less than 2 cubic feet per hour for every square foot of bed space, the mushrooms will appear abnormal, having long stems and small caps, and there may be many small mushrooms or none (5, 6). It has been estimated that 5 cubic feet of air change per square foot of bed space per hour is necessary to keep the carbon dioxide level of the air in the growing room below one-half per cent. (10). The minimum requirement for the best crops is probably between 5 and 10 cubic feet of air space per square foot of bed space per hour (5, 7, 10). Excellent yields of normal mushrooms have been obtained when 10 cubic feet of air was introduced per square foot of bed space per hour. Drying out

of the mushrooms on the bed imposes a practical limit on excessive introduction of fresh air. Some movement of air over and around the mushrooms is not only desirable but necessary to remove the stale air from the surface of the mushrooms and replace it with fresh air. A somewhat greater rate of air change may be necessary in long passage ways in which the fresh air comes in at one end of the tunnel and moves in and around growing beds throughout the length of the tunnel before reaching the outlet. With this arrangement the concentration of toxic gases will be greatest at the outlet end of the tunnel. The ratio of air space to bed space is not very important when the air is moved at a constant and adequate rate with fans or blowers, since the ratio of toxic gases to fresh air soon comes to an equilibrium which remains the same no matter what the ratio of air space to bed space (5).

Ventilation with fluctuating air movement during cropping: Nearly all commercial mushroom houses in the United States are ventilated by means of small doors at the floor level and openings in the ceiling. The air moves through these ventilators at a fluctuating rate, depending on the difference in temperature inside and outside the mushroom house and on the direction and velocity of wind outside. This causes an intermittent type of ventilation. Under these conditions the ratio of air space to bed space in a mushroom house is very important (5, 10). Studies made in England showed that an air space in relation to bed space of 4 cubic feet of air per square foot of bed is probably the smallest ratio that will provide satisfactory growing conditions (7, 10). A somewhat smaller ratio may be satisfactory under conditions in Pennsylvania in the winter.

Yields may be reduced as a result of poor ventilation without any apparent abnormal growth of the mushrooms on the bed (7, 10). Studies in England showed that differences in the ratio of air space to bed space were responsible for differences in yield of as much as 1 lb. per square foot. As a part of these studies it was shown that in a house with a low ratio of air space to bed space the total yield of mushrooms in the house was increased by filling only 4/5ths of the bed space (7, 10).

Shall I increase the ventilation in my houses? If you are using forced ventilation it should be a simple matter to answer this question. Measure the flow of air either coming into the house or leaving it. If the flow adds up to less than 10 cubic feet of fresh air per hour for every square foot of bed space, the rate of air flow should be increased.

Most growers do not use forced ventilation and cannot obtain a satisfactory measure of the average rate of ventilation because it varies from day to day, week to week, and season to season. Perhaps the best course of action for these growers is to increase the size of the floor level ventilators in every second house and keep a record of the house yields to determine whether the increased ventilation increases the yield of mushrooms. We should keep in mind that mushrooms grow faster at high temperatures than at low temperatures and, therefore, need more ventilation at high temperatures.

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I was recently asked by a close friend of mine, who is a highly successful Mushroom Grower, to make a Ciné film of the mighty array of machinery being used to prepare the site for a considerable extension to his Farm. I filmed this awe-inspiring display of mechanisation in the pouring rain, and came away thoroughly depressed.

I have just emerged from the ' frying-pan ' of Watery Stipe into the 'fire' of over-production and bad prices. Has not the moment arrived when the Spawn contribution should be raised to 1/- per carton, in order to give the Publicity Committee the necessary funds to save the industry?

Raymond Thompson.

AND HE SAYS:—2d. PER CARTON IS UNREALISTIC

I consider the present publicity levy of 2d. on each carton of spawn quite inadequate for the purpose and have requested my spawn suppliers to increase this amount to 10% of the charge per carton. It is high time, I think, that this matter of publicity contributions was put on a more realistic level.

E. PALFREY.

STORE PUBLICITY FOR MUSHROOMS

At the eight main stores of Messrs. Lewis's Ltd., Glasgow, Manchester, Liverpool, Leeds, Leicester, Hanley, Birmingham and Bristol, special " mushroom weeks " were held in February. Attractive displays were staged at each store with growing mushrooms on show in the shop windows. Publicity matter, supplied by the MGA, was distributed from each store. The result of this publicity effort is awaited with considerable interest by the MGA Publicity Committee.

1958 PUBLICITY FUND — Some Contributions Increased

The 1958 Publicity Fund appeal has got away to a good start and the Publicity Sub-Committee have pleasure in acknowledging the undermentioned contributions.

The Committee note, with particular pleasure, that some contributions show a substantial increase over the 1957 figures, a fact which the Committee finds greatly encouraging.

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†Previous contributions (1958) already acknowledged.

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*Amounts collected by spawn merchants are not for publication.

COMMITTEE ELECTIONS—*Continued from page 84*

Area A

For a number of years this area has had an unofficial committee, comprising G. V. Allen, W. A. B. Harding and G. W. Baker, and this committee has organised all the farm walks and meetings held in the area.

A meeting date will shortly be announced when it is hoped as many members as possible will attend and elect the area's new committee.

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THE EFFECTS OF AERATION AND LIGHT ON TOADSTOOLS

By

B. E. PLUNKETT, PH.D.

(Lecturer in Botany at Birkbeck College, University of London)

Many important biological discoveries have resulted from the intensive study of one organism. On the other hand the biologist is ill-advised who ignores the comparisons which may be made between different species. What follows is mainly to do with the allies of the mushroom (roughly speaking toadstools) but may perhaps have a bearing on mushroom research.

The mushroom-like fungi (the Hymenomycetes) fall into two groups. Firstly, there are those with gills (the Agaricales) which include most of the soft fleshy toadstools with centric stalks like the cultivated mushroom. Secondly, there are those in which gills are replaced by other structures like spines, tubes or even smooth surfaces. These are the Aphyllophorales; and while a few look like umbrellas many are one-sided bracket fungi, often growing on wood and usually rather leathery in consistency.

It is well-known that fruit-bodies of Hymenomycetes growing in special situations such as caves, mines and cellars are often grotesquely abnormal. Outstanding features of the abnormalities are very much reduced caps and long stalks which are often branched. Now these freaks are of the greatest interest because they suggest that the developmental processes of the fruit-bodies must be very sensitive to external conditions. Caves and cellars are usually dark and may have relatively stagnant air; and, as we shall see, some of the consequences of these states may be the ones upsetting normal growth in toadstools.

I have studied two species, *Collybia velutipes*, a typical fleshy agaric (eaten by the general public in the far East and by those in the know elsewhere) and *Polyporus brumalis*, one of the Aphyllophorales with a central stalk like a mushroom but having tubes instead of gills. It is also rather tough and would be very indigestible. In a confined space with unchanging air, especially at low light intensities, both these species develop odd-looking fruit bodies with long stalks and with tiny caps or even no caps at all. Under certain conditions the passing of fresh air over them, in fairly strong light, prevents the abnormalities.

When a fungus grows in still air of limited volume a number of changes may be expected in the atmosphere. Oxygen is depleted and various volatile products of the fungus will accumulate, especially carbon dioxide and water vapour. As aeration was beneficial to the two fungi studied, the question which arose was: which if any of these things interferes with normal developmental processes? This was investigated in a series of experiments.

Full technical details cannot be given, but important features must be mentioned. Firstly, all the experiments were done with pure cultures. This means that the glass vessels, the nutrients and the culture

atmosphere were not merely pasteurised but sterilised and the fungus itself was uncontaminated with other microbes, even bacteria. Thus the possible effect of any other organism as a disease agent (pathogen) or as a producer of toxins was completely ruled out. If only this could be done in studying the new mushroom disorder!

In some experiments absorbing substances capable of removing certain vaporous or gaseous fungus products from stale air were included in the culture chambers. The most important experiments, however, involved the passing over the fungi of sterile air or other gas mixtures, preconditioned as to their water-vapour content. Thus in some cases different culture chambers received air of different relative humidities. In other cases gas mixtures like air but enriched with carbon dioxide at the expense of nitrogen flowed over the cultures (normal air has approximately 20·94% oxygen, 79% nitrogen, and 0·03% carbon dioxide). Naturally, as each particular suspected agent was studied as many other factors as possible were kept constant. Temperature and concentration and nature of the nutrient solutions were always the same. While humidity was studied, oxygen, carbon dioxide concentrations and light intensity were constant. While the influence of different light intensities was being investigated, aeration conditions were the same in all chambers. It is by such means that one can separate out the effects of each factor.

At the end of the growing period the dimensions of the parts of the fruit bodies were determined and average values for samples were compared.

The results were striking and clear cut. Both fungi, however favourable other conditions, required light for normal cap development. In *P. brumalis* it was possible to see that larger average cap diameters resulted as light intensities were increased over a certain range. Interestingly, stalks were either unaffected in their growth by low light or, as in *P. brumalis*, were considerably longer than usual.

In the gilled fungus as little as 1% of carbon dioxide in the culture atmosphere measurably diminished average cap diameters as compared with specimens in fresh air, while 5% of carbon dioxide stopped cap development and retarded even stalk growth, which had been insensitive at the lower concentration. On the other hand 5% of carbon dioxide had no adverse effect whatever upon *P. brumalis*.

No evidence was obtained that reduction of atmospheric oxygen concentration down to about 1% was important for either fungus.

Collybia velutipes suffered no ill effect in air streams as nearly saturated with water vapour as I could make them, although fast-moving dry air could completely arrest the growth of all the parts of the fruit body. It is almost meaningless to state actual humidities because it is their effect upon fungus water loss which matters, and this is also controlled by the renewal rate of the atmosphere and the surface area of the fungus. Under the conditions of the experiments, growth was arrested when each square centimetre of fungus lost about 1·4 milligrams of water vapour per hour.

P. brumalis was dramatically different. Low evaporating rates (i.e., slowly moving, moist atmospheres) powerfully affected fruit-bodies. Fewer were formed, caps were later in appearing and their average diameters were much reduced. Again it was noteworthy that stalks grew to much greater lengths than normally. I have since discovered that reduction of water loss from this fungus greatly diminishes the rate at which materials are transported up the stalk (this can be measured by watching the movement of dyes added to the nutrients). It seems very likely that an insufficient supply of one or more substances from below limits cap production in moist air.

What are the lessons of these experiments? Clearly the fruit-bodies studied are very plastic structures. Their development can be influenced profoundly by external factors. One aspect of development, for example cap enlargement, is often sensitive to more than one agent. Different developmental processes (e.g., cap and stalk development) have different physiological tolerances.

To hear, then, that certain recently important mushroom disorders such as Brown disease or La France are accompanied by malformation is no surprise. Indeed, if the mushroom is like the toadstools which have been investigated, it would not be surprising if many different disorders caused similar abnormalities. Perhaps drumsticks, " onion " stalks and so on, are like back-ache and asthma, not one disorder, but common symptoms of a variety of different maladies.

This view of mushroom abnormality is, to some extent, borne out by knowledge actually available. **Lambert** in 1933, showed clearly that, as in *Collybia velutipes*, elongated stalks and reduced caps can be produced in cultivated mushrooms by as little as 1·8% of carbon dioxide. Later **Mader** and **Stoller** too related the same or similar abnormalities to unidentified gaseous substances other than carbon dioxide. It is not generally realised that Mader's and Stoller's discoveries in no way invalidate Lambert's work. Indeed one of Mader's experiments probably confirms it. Here, perhaps, is a case of similar developmental upsets being caused by different agents. In view of the dense crowding of sporophores in a modern flush of mushrooms a re-investigation of the atmosphere between and beneath the caps might not be inappropriate. Volatile toxins could, of course, originate either from the mushroom or from associated organisms.

One advance which could be made in the study of misshapen mushrooms would be to define the abnormalities quantitatively to avoid the confusion of similar but not identical symptoms. **Gandy** and **Flegg** have already made steps in this direction by investigating the dimensions of the " normal " mushroom and deviates from it. Perhaps an old method used by toadstool enthusiasts—the straightforward determination of the ratio of stalk length to cap diameter—has special advantages in involving no assumptions about the normality of either of the parts. It places emphasis on proportions rather than absolute dimensions.

The requirement of light for normal cap production in *C. velutipes*

and *P. brumalis* can be paralleled in several other toadstools and bracket fungi. The cultivated mushroom in having, so far as one knows, no need for light appears as a great exception.

Evidence of the effect of evaporating conditions on fungi is very slight. However, *C. velutipes* appears to be like *Coprinus lagopus* (a small ink-cap) and perhaps even the mushroom (see the limited experiments of Mader) in being rather insensitive to high atmospheric water vapour content. In contrast, *P. brumalis* and probably another of the Aphyllophorales, *Ganoderma applanatum*, are readily upset developmentally by moist, slow-moving atmospheres. Whether this will prove to be a general difference between gilled and non-gilled Hymenomycetes remains to be established. However, the preliminary suggestion that low evaporation has little direct effect on agarics does not rule out the possibility that such conditions could favour mushroom disorders in commercial houses. Slow water loss could indirectly affect mushrooms by encouraging some intermediate agent such as a pathogen or toxin-producing inhabitant of the compost or casing.

To an outsider, the investigation of the new mushroom disorder(s) seems a difficult matter. Account will have to be taken of the possible instability of hereditary characteristics of the spawn, and its perfect freedom from contaminants ensured. It must be established whether a pathogen or unfavourable microbial associate is involved; which may call for pure culture experiments to the stage of fruiting. Further, it may be advisable to apply methods like those used with toadstools to the analysis of the direct effect of physical and chemical factors of the atmosphere. This is a formidable programme but may well be the one which would most quickly give lasting improvements.

WORLD'S PRESS DIGEST

The reduction of prices by **the processors** in December delivered a crushing blow to mushroom growers. Growers can't hope to survive if they are to rely heavily on an outlet that, overnight, can pull the rug right out from under them. *AMI's Mushroom News*, January/58.

Monsieur Zinetti, president of the French growers, reported with regret that, just when they had launched a new publicity campaign, **the canners** had dropped their price by 10 francs a kilo. The canner said they had been offered many more mushrooms than usual, and their stocks were accumulating. They warned growers of the dangers of over-production. *French Federation's Bulletin*, January/58.

Over-planting of mushrooms, potatoes and tomatoes is reported in New South Wales, Australia. Canneries are working to capacity on mushrooms, but there will be a surplus. *Grower*, January 18/58.

The **low mushroom prices** at Christmas livened up the retail trade. Most greengrocers always hope to buy low enough to go out with price tickets of 1s. a quarter pound. At this price, they say, mushrooms will sell like hot cakes. But this means buying in the market at 3s. per lb., which growers say is not a high enough average price to keep them

in business. It is thought that many of the large chain stores would be willing to buy regular heavy quantities throughout the year from any grower who would undertake to supply them at this price.

Grower, January 18/58.

A washing and packing operation has been developed by Vincent J. Santucci, an Avondale, Pa., grower, with the assistance of University of Delaware staff members. After the mushrooms are washed in a special solution to remove dirt and hyphae, they cannot be bruised. The washed mushrooms move on conveyors to the drain table and then to the sorting and packing tables. The filled containers head for the wrapping machine and the wrapped product is packed into cartons for shipping to market. It's a continuous operation.

AMI's Mushroom News, January/58.

We don't consider **over-production** is our major problem. Just under-education (of the consumer).

AMI's Mushroom News, January/58.

" We (at the Glasshouse Crops Research Institute, Littlehampton) also work in close touch with **the mushroom industry**, which is larger than many people realise; in fact in terms of value of produce it is probably next to tomato production."

F. W. Toovey, in an interview in *Worthing & West Sussex Growers' Magazine*, January/58.

Since the war the **supermarkets** in the United States, particularly the nation-wide chains, have come to dominate the whole horticultural marketing picture. They deal with at least 80 per cent. of the horticultural production, and are therefore able to dictate prices to a large extent. Donald M. Whittome in *Grower*, January 18/58.

Plastic-handled 6 in. **screwdriver** incorporates wire stripper which severs and strips insulation in one action. Made by Jilton Manufacturing Co. Ltd., 539 Holloway Road, London, N.19, it cost 3s. 6d.

Scope, January/58.

Coupled with rising standards of living is the demand for finer *types* of food. The clever grower and the clever merchant and the clever retailer will stick to top **quality**, come what may.

Alec Blacke in *Fruit Trades' Journal*, January 4/58.

Formation of an **International Vegetable Growers' Association** has been announced. The foundations were laid at a meeting in London in 1957 attended by leading British vegetable growers. Walter F. Pretzer, of Cleveland, Ohio, U.S.A., was elected president and Mrs. N. Stewart, of London, acting secretary. Present headquarters of the new body are at 49 Doughty Street, London, W.C.1. International fellowship is considered necessary if producers are to keep pace with the rapid development of science. *Grower*, January 4/58.

Mr. J. Bunyan, of Messrs. Duncan Tucker, said it was in the field of **ventilation** that glasshouse growers would see the greatest changes in the future. Already there was the completely ventless house which, by means of extractor fans in the ends and shuttered louvres in the sides, was capable of providing up to 60 air changes per hour.

Commercial Grower, January 24/58.

Dr. John Hawthorn emphasises that although the **storage life** of food may be extended by keeping it at temperatures around freezing point, microbiological growth is possible down to temperatures of around 23 degrees Fahrenheit. *New Scientist*, November 21/57.

I was surprised to see some mushroom houses decorated with twisted coloured lead foil strips, and was told that if they were hung correctly here and there they gave a good indication of the **air flow** and whether it was too much or too little, so that ventilation could be controlled accordingly. *Grower*, January 4/58.

Horticulture has suffered from inflation, and the most strenuous efforts are being made to alleviate horticulture's inflationary burden. Applications for **tariff adjustments** have been submitted for certain important horticultural commodities. (Sir James Turner at NFU Annual Meeting.) *Nurseryman Seedsman*, January 23/58.

I suggest that the new Chancellor of the Exchequer should make **credit facilities** more easily available for horticulture. The Farm Improvement Scheme, for example, might be extended to cover more specifically-horticultural subjects: if goat sheds, why not glasshouses? Wayfarer in *Nurseryman Seedsman*, January 16/58.

The facts of **genetics**—that genes do not blend in heredity, that small heritable variations or mutations are always occurring and can be stored in the hereditary constitution awaiting their evolutionary opportunity -are the basic data on which neo-Darwinian theory is erected. Dr. Julian Huxley in *Sunday Times*, January 5/58.

The total tonnage of traffic through the books of **Worthing & District Growers Ltd.**, at 9,068, showed a decrease of 39 tons, a decline obviously accounted for by the reduction of the area of glass in certain parts of the district. Both tomatoes and cucumbers showed a reduction of 10% in the number of packages forwarded, whereas there was an increase of 22% in the mushroom traffic and 5% in flowers.
Report of Directors of the Company, January 22/58.

One week in the French pavilion at the **Brussels World Fair** would be devoted to mushrooms. *French Federation's Bulletin*, January/58.

Exports of fresh mushrooms from France to Switzerland and Germany had been increased from 17,800 kg. to 38,200, and from 3,900 kg. to 26,800, respectively, in 1957. But sales to Britain had fallen from 15,100 kg. to 11,900. Exports of canned mushrooms to Britain had risen from 141,200 kg. to 158, 300, but the principal market was the United States, which imported 1,453,800 kg. compared with 1,384,700 kg.
French Federation's Bulletin, January/58.

ELECTED TO P.P.D.A. COUNCIL

Major A. L. A. Dredge, lively MGA member from Combe Bank Market Gardens, Sundridge, Kent, has been elected to the Council of the Prepackaging Produce Development Association, Agriculture House, Knightsbridge. He is the only mushroom grower member of that organisation.

Let us talk about . . . . . .

OUR OWN PROCESSING PLANT

One of the Mushroom Industry's most pressing needs to-day is price stabilization in a period of rapid expansion. Publicity can contribute towards this if it is on a large enough scale. Processing of the poorer quality mushrooms and all stalks, to remove them from the fresh market, would be equally valuable; but the canners in general demand only the best quality. To establish our own processing plant would require considerable courage and much capital, but **the Executive Committee would like you to study the following observations so that we may talk it over at the Annual Meeting on 18th March.**

Let us assume that the MGA sets up and operates its own processing plant which would automatically buy all mushrooms that did not fetch a pre-fixed price in the fresh market. This plant would not be forced to rely entirely upon the normal laws of economics since, unlike other concerns, its primary object would not be to make a profit; instead its owners (we growers) would benefit by the better and steadier price for the mushrooms they grow rather than from their processing company.

Our own processing company would be charged with devising all sorts of new products with mushrooms as a base. There would be great scope here if really competent brains were employed.

All wholesalers in all markets would be instructed to consign to the processing plant any mushrooms not reaching a specified minimum price, and all stalks.

So far it sounds quite attractive; but where is all the money coming from, the heavy capital and the equally heavy working expenses? Since the main object of the plant would not be to make a profit it would not attract any outside investor; therefore we can go no further at this stage, perhaps, unless we assume that it will be possible to raise *a short-term loan* of, say, £50,000. The Government might be sympathetic, once the present crisis is resolved, because much of our processed products would be exported, thus creating foreign exchange for the Treasury; and one of the Government's avowed objectives is to assist Horticulture and help stabilize prices.

Assume, then, that £50,000 can be borrowed for, say, five years. *Each grower* would be asked to sign a document agreeing that, for those five years, one-twelfth of a penny is deducted by the market wholesaler for each pound of mushrooms sent to market; for example, if a grower sends 500 lb. of mushrooms to market he has 3/6 deducted from his proceeds. (But at the same time he gets a better price for the 500 lb., which could amount to many times the 3/6 deducted.) It is estimated that this should amount to about £50,000.

Each wholesaler would be asked to pay periodically to the Government, or whoever lent us the £50,000, the one-twelfth of a penny deducted from the grower's account. We feel he would be willing to make these

small deductions since it causes him no more work than collecting the normal handling changes, while he gains (*a*) in making a higher commission on the higher average prices anticipated, (*b*) he does not have to worry about or provide cold-storage space for mushrooms unsold, and (*c*) he cuts his selling costs by clearing all the lower-priced mushrooms to one customer, our processing plant.

If some such scheme were found to be practicable, it would probably be considered desirable to form a company within the Agricultural Central Co-operative Association, for the MGA by its constitution cannot carry on a trade or business.

But why £50,000, you may ask ? It is an estimate (which several think is too modest) of the cost of setting up and equipping a cannery to deal with a large tonnage of mushrooms daily. The breakdown is: Plant £18,000; Equipment £18,000; Working Capital £14,000. But there are other, less costly, forms of processing.

Let us talk about it at the AGM.

TERRIFYING EXPERIENCE

Two well-known MGA members and three of their children were involved in an alarming mishap when on a winter sports holiday at Kirchberg, Kitzbuhel, Austria.

Mr. Raymond Thompson of Church Farm, Wittering, Chichester, with his two children, Tracey (15) and Carleton (13) were on a chair lift with Mr. S. A. F. Sampson of Oving, Chichester, Mrs. Sampson and their two children, Adrian (12) and Barry (10).

Mr. Thompson and his children were ahead on the lift with Mrs. Sampson at the rear when, as the result of a fault, Mr. Sampson and three of the children, Carleton, Adrian and Barry lost their seats and dropped to the ground, together with a German.

At the time of the accident the party was ascending the slopes preparatory to a ski run and although the ground underneath was covered with snow some 2 ft. deep, stubs of felled pine trees protruded and added to the terrifying danger.

Carleton fell about 60 ft. and sustained a gashed head which necessitated several stitches. The two Sampson children fell 40 ft. and were relatively unhurt, apart from a bad shaking. Mr. Sampson and the German fell about 15 ft. and escaped injury.

Mr. Thompson and Tracey, at the head of the party, were unaware of the seriousness of the accident, but Mrs. Sampson, at the back, saw it all happen.

Mrs. Sampson, Mr. Thompson and his daughter, along with many others, remained marooned on the lift for some considerable time before the fault was rectified and Mr. Thompson was able to ascertain the extent of his son's injury.

COMMITTEE ELECTIONS

By G. W. BAKER

The approval given at the last Annual General Meeting of the scheme whereby Members of the Executive Committee are elected by Postal Voting and are representative of the whole of the United Kingdom is being put into operation.

After the elections this month, we shall have all areas as defined in *Bulletin* 87, page 99, represented on the Executive Committee. Areas B, C & F, will be represented by members elected by postal voting this year.

Whilst the two General seats will be filled by ballot at the AGM this month, postal voting will be used in future for filling all vacant seats.

There are a few points which must be made clear in connection with the new scheme.

1. Only Grower Members (not Associate Members) may nominate a member.
2. All nominated members must be Grower Members.
3. Only Grower Members may vote.
4. For **Area Seats** items 1, 2 & 3 apply and members nominating, nominated and voting **must** be members of the area concerned.
5. Members who have served two consecutive terms of three years on the Executive Committee are not eligible for re-election until a period of 12 months has elapsed.

The seats are at present filled as follows and become vacant in the years shown.

	General Seats (6)		**Area Seats (9)**
1958	FILMER.	Area B.	GOOK.
	BAKER..	C.	ATKINS.
		F.	LAWRENCE.
1959.	ALLEN.	Area D.	SPENCER.
	LINFIELD.	E.	BLEAZARD.
		G.	CAMPBELL MELVILLE.
1960.	COOPER.	Area A.	REED.
	STEWART-WOOD.	(3 Seats)	BERRY.
			STANLEY-EVANS.

Your committee sincerely hope you will give your full support to the scheme by using your postal vote and nominating only members who will be of real value to the Committee.

Areas are to be encouraged to form their own Area Committees with a view to this committee organising farm walks, discussions, meetings, etc., in the area and by so doing, bringing the members together more frequently.

However small the number of growers meeting, an interesting exchange of view takes place and friendships spring up.

Members' views can be expressed at these gatherings and can reach the Executive Committee via the member from their area, representing them on the Executive Committee.

Continued on page 74

● UP AGAIN

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Searles Gardens,
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Dear Sirs,

Seeing the reports of various Mount users in your adverts in the Bulletin from time to time, I thought you would be interested to know of my own results.

You will be aware that I have now spawned regularly with your Mount White, both Moist and Granular, for close on two years and during this time have used many hundreds of cartons. We grow in the standard Danish fish box (composted stable manure) and crop for six weeks. Over a period of twelve months we have averaged 1·9 lb. per sq. ft., several crops exceeding 2 lb., and latterly it has been the exception rather than the rule to crop less than 2 lb. In fact our best crop recently has done 2¾ lb. As a point of interest, this has occurred since we adopted your suggestion of spawning with 25% of your White Grain, in addition to the Moist White manure spawn.

An outstanding feature of our cropping has been the really excellent quality of mushroom produced. We are delighted with the results and you may use this tribute as you wish.

Yours faithfully,
(signed) A. Sanford.

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Reprinted from the AMI *Mushroom News*, of January, 1958.

DISCOLOURATION FINDINGS NOTED— LONGER SHELF-LIFE IS THE GOAL

Talk by Donald H. Hughes, Food Technologist, University of Delaware

This talk has been entitled, " Some Chemical Properties of Mushrooms and How They Affect Your Marketing." In this report we shall consolidate the research and extension work of the past year. That is, rather than present a progress report on research on discolouration, I will gather together the loose ends of our project so that the overall objectives, and results, will become clearer to all.

The discolouration problem encompasses, as I see it, the following basic aspects:

A. Chemistry of the browning process.

B. Practical problems—that is, physical effects that aid in preventing discolouration.

C. Related problems that are a direct outgrowth of the discolouration process.

The methods we have used in attacking the first point have been outlined in previous reports both here and at Penn State. It will be sufficient to remind you that the discolouration is a direct result of the action of a powerful oxidizing enzyme called polyphenol oxidase. As a consequence the discolouration of fresh market mushrooms shows the characteristics of an enzyme controlled reaction, namely: (1) a marked dependence on temperature—this explains why low temperatures maintained throughout merchandising channels help to prolong shelf-life, (2) a direct relationship between enzyme activity and the concentration of either enzyme or substrate (that chemical compound or food which the enzyme feeds on)—this explains why bruising of the mushroom results in increased browning. That is, if we assume the enzyme is located in one place in the cell and the substrate in another, then browning will not occur until they come into contact. This, of course, takes place by bruising the mushroom. As you may recall many avenues of attack were explored before any measure of success was attained. The most successful route led to the use of reducing agents such as ascorbic acid, sodium bisulphite and sodium sulphite, and the thiol containing compounds such as glutathione and mercaptoacetic acid. Ascorbic acid can be classified as a mild reducing agent while the sulphites are strong reducing agents. The thiol containing compounds may be weak or strong; however, the interesting point about them is that they may form a chemical bond with the substrate (or enzyme food) in addition to their reducing ability. This is our explanation for the fact that they enhance the natural colour better and increase the shelf-life longer than any other class of compounds tested. We can demonstrate

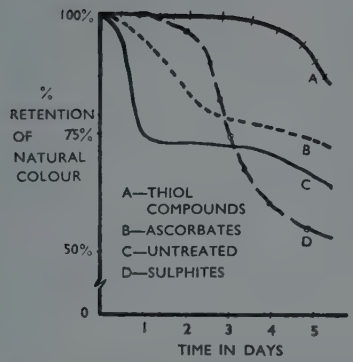

FIG. 1: EFFECT OF VARIOUS TREATMENTS ON SHELF-LIFE

this graphically (Figure 1). We must note that these are the results of visual observation. The use of these thiol containing compounds is a recent idea and poses many problems; chief among which is toxicity, that is to what degree they can be safely eaten. There are a number of these compounds available and proper evaluation is essential before any recommendation can be made.

You may ask at this point, why, if the reducing agents inhibit the browning reaction, are other chemicals added to the commercial formulations now available? The answer to this is that in general the action of the reducing agents is enhanced in the presence of these other materials. Thus the formulation proposed by Dr. Goodman, of the University of Missouri, contains sodium bisulphite plus salt (NaCl). Another commercial formulation on the market contains, on the basis of our analysis, sodium sulphite plus salt (NaCl). Here the salt has a dual function; it not only protects the sulphite from vaporizing but also aids in firming (or hardening) the mushroom after treatment. A detergent wash merely opens the mushroom by reducing the surface tension so that more sulphite is taken up into the mushroom. Citric acid acts as a buffer, whole sodium citrate and dextrose again reduce surface tension to permit a greater flow of sulphite into the mushroom. I would like to demonstrate this phenomenon called surface tension. It is somewhat like trying to place a round peg into a square hole. To illustrate this I have a rubber band and marble. When the rubber band is stretched (representing the mushroom surface) the marble (which represents the chemical) cannot pass through. However, if we reduce the tension on the rubber band, the marble, as you can see, will easily pass through the rubber band into the mushroom. One must be careful when using detergents though, for when too much tension is removed the cell collapses and the mushroom is ruined.

Now, the problem remaining in the chemical control of discolouration is to find a safe, inexpensive reagent that will keep the mushroom absolutely white for at least five days under adverse temperature conditions. We say this because when laboratory experiments are taken into the field at least one day of shelf-life is lost. We attribute this to the harsh handling encountered in the shipping and transport operation. Beyond the thiol compounds we mentioned earlier are several as yet unexplored areas. Among these are adenosine triphosphate (ATP), nitrogen packaging and anti-enzyme systems.

Now to turn to the "Practical Problems" mentioned above. These are all the physical factors which aid and are important in preventing discolouration. Chief among these practical problems is the

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FIG. 2: PROPER HYPHAE REMOVAL

The spikes represent young hyphal strands that easily break open and start the browning reaction

removal of the hyphae illustrated in this diagram (Figure 2). Regardless of the type of treatment used it is essential that the washing action be adequate for complete removal of hyphal strands, particularly with first break mushrooms which seem to possess an overabundance of these hyphae. To our knowledge a mechanical washer that performs this job properly has yet to be devised. However, several effective, man operated methods are presently in operation. The essential step is to overload the washing tank with mushrooms and then apply a gentle sloshing action either by hand or with sponge rubber lined plungers. In this way the mushrooms will roll and slip by one another—literally washing themselves.

A " Practical Problem " which nearly refused to yield to solution was that of drying the mushrooms after treatment in a way conducive to a continuous production line fashion. We have been fortunate in discovering a practical and inexpensive method to do just that. Since force driven air results in air burns, most growers who have been washing have utilized indirect or reflected air; or have simply allowed the mushrooms to sit at room temperature for several hours. Since this represents a considerable loss of time and productivity we tested methods that could be fitted to a conveyor type of system. We theorized that infra-red drying lamps set in banks along the conveyor would dry the mushrooms in much the same way that automobiles are dried after painting. However the product became dry only after a five-minute exposure. This and the fact that areas not directly in the path of the infra-red rays remained moist, led us to discard this method. Then, after interesting but rather devious methods of thought, we discovered that mushrooms can be effectively dried by capillary action. That is to say, by placing the mushrooms on an absorbent surface the moisture will be removed not only at the contact area but from the entire surface. This we explain by the fact that the mushroom is sponge-like in nature thus providing its own wick to the absorbent material. We tested this, on a production line, with terry cloth towelling but immediately ran into the problem of drying the towelling. The ideal drying material should be easily squeezed or wrung out, thus suggesting sponge and a pressure roller. We contacted the DuPont Co. and by chance found that they possessed a new product called " sponge sheeting " which incorporates a cotton fibre backing within the synthetic sponge. We are in the process of glueing this and two other types of sponge to a canvas or rubber belt in order to ascertain which type will provide the desired results (i.e., drying rate, shelf-life, cost and length of service). To our knowledge this method of drying has never before been used on fruits or vegetables. It seems to us that it would have a wide application. This method is thoroughly adaptable to a production set-up and has the added advantage of handling the product gently, thus decreasing bruise injury.

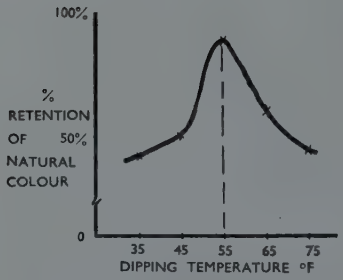


Fig. 3: Mushrooms treated with Sodium Bisulphite showing optimum temperature to be approximately 55°F. Concentration 1000 PPM. pH 6.0

Another practical problem that has been worked out is the demonstration of an optimum dipping temperature (Figure 3). Thus, even though low temperatures are beneficial to the shelf-life, a limiting factor is imposed in the dipping operation.

There is an additional practical problem, that is, in some ways, controversial. It has been demonstrated that mushrooms picked "tight," that is the veil has not yet opened, will respond better to treatment and will add at least one day to the shelf-life. This means that the washing and treating of fresh market mushrooms not only presents a desirable, white product but also a firmer product of high quality. These facts have been established. The controversy arises when a number of growers feel that by picking tight they are losing a portion of their yield; in effect cutting off dollar bills before they are fully up on the beds. Now, to my knowledge figures do not exist to either prove or disprove this claim. However, growers who have washed mushrooms, and consequently picked "tight," report no loss in yield in terms of pounds per square foot.

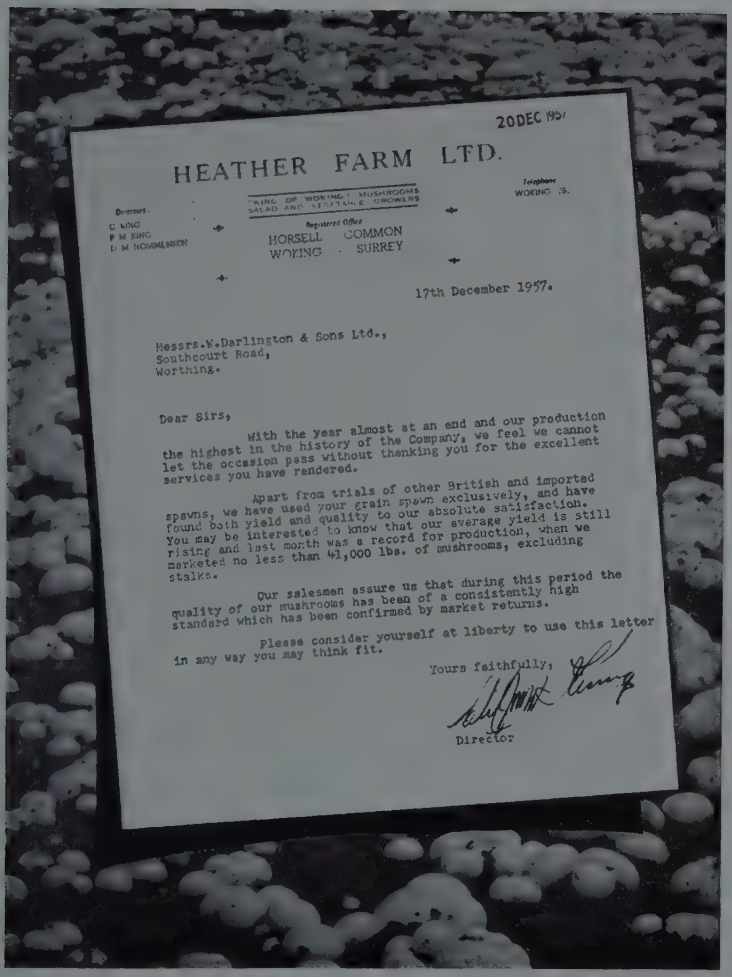
I would like to turn now to the related problems that are a direct outgrowth of the discolouration research. The major problem in this group is the fact that a difference exists between breaks of mushrooms. We call this the first vs. third break problem, and this much we know about it:

1. First break mushrooms generally are of poorer quality in terms of shelf-life than succeeding breaks.

2. First break mushrooms generally do not respond to chemical treatment as well as succeeding breaks.

3. First break mushrooms represent anywhere from 25% to 50% of the total crop and yet—as evidenced by prices in early fall and after February refill—bring a lower profit on the market.

Thus, because of this phenomenon, everyone in the mushroom growing industry suffers financially. In an attempt to explain this disparity we have undertaken a nutritional and composition study of the mushroom, using chromatographic techniques which we detailed at Penn. State last summer. These techniques have made it possible for us to demonstrate that, in the amino acid make-up of mushrooms, a significant quantitative difference exists between breaks. Alcohol extracts on precise amounts of first, third, and fifth breaks were chromatogramed and developed. Of the nineteen spots which appeared on the paper only one amino acid, tyrosine, differed in intensity between breaks



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17th December 1957.

Messrs.W.Darlington & Sons Ltd.,
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Worthing.

Dear Sirs,

With the year almost at an end and our production the highest in the history of the Company, we feel we cannot let the occasion pass without thanking you for the excellent services you have rendered.

Apart from trials of other British and imported spawns, we have used your grain spawn exclusively, and have found both yield and quality to our absolute satisfaction. You may be interested to know that our average yield is still rising and last month was a record for production, when we marketed no less than 41,000 lbs. of mushrooms, excluding stalks.

Our salesmen assure us that during this period the quality of our mushrooms has been of a consistently high standard which has been confirmed by market returns.

Please consider yourself at liberty to use this letter in any way you may think fit.

Yours faithfully,

Director

FOR ALL METHODS OF GROWING

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PRODUCTIVE, PURE CULTURE
MUSHROOM SPAWN

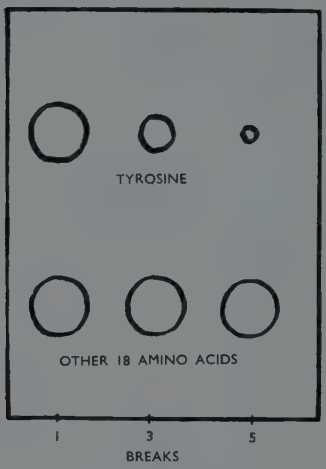

Fig. 4: Diagrammatic representation of a chromatogram of the alcohol extract of fresh mushrooms showing the tyrosine difference

(See figure 4). Thus the tyrosine spot was strong in the first break, weak in the third break, and almost non-existent in the fifth break. At the same time the other eighteen amino acids exhibited no visual difference between breaks. Now you may ask why, if only one of the nineteen amino acids shows a break difference, is this finding of any importance? The answer is two fold: (1) Of the nineteen amino acids on this chromatogram only one has been implicated as a subtrate for the browning enzyme. That amino acid is tyrosine, and (2) the decrease in tyrosine concentration with succeeding breaks parallels the improvement of quality and shelf-life. Thus, as tyrosine decreases, quality improves. This finding enables us to unlock many doorways in our search for an understanding and a control of the browning mechanism. We are presently in the middle of this work and results will be forthcoming. It is our hope that the basic knowledge gleaned from this work will enable growers to minimize this difference and receive a better return for their dollar. In addition this amino acid and carbohydrate study should aid the publicity campaign of the AMI. A possible practical application of this work is that the stem waste which is worthless at present may prove to have a value as a by-product, either as a source of sugars or amino acids.

This summarizes our work to date on the chemical properties of mushrooms and their affect on marketing.

TWO REPLIES TO MGA ——— SEE OPPOSITE

I thank you for your charming Valentine
And do assure you I am always thine.

When I was young and fortunately tough
Of mushrooms I could never eat enough.
And still I love of all foods thine the best
Tho' motor tyre is apt to stretch my vest.

Then in the morning early I did rise
And search the meadows for the cherished prize
Of Mushrooms coyly hiding in the dew
For in those days I had not heard of you.

But now on chilly morns in bed I lie
Until the sun is well up in the sky.
At noon to nearby shops I make my way
Find Mushrooms there, thanks to the MGA.

Should you require to know my name, it's Joan,
My number's 284 upon the phone. J.G.

(J.G. is Mrs. Joan Gardner of Steinbrook, Kington Langley, Nr. Chippenham, Wilts., wife of the Chairman of the NFU Central Horticultural Committee.)

Mystical Muse of Minute Mushroom,
That's likened to an atom's cloud,
Your tempting Valentine will strengthen
A love that's often been avowed.

Poet of Parasol Pink-bellied,
Cupid's already done his most,
Your charms and mine have long been wedded
With mushrooms on hot-buttered toast.

(from The Milk Advisory Bureau.)

"WILY BIRDS LOOKING AFTER MGA PUBLICITY"

(says the "*Nurseryman and Seedsman*")

Graphics by Ronald Searle; Lyrics by Eric Keown.
(Picture by courtesy of *The Grower*)

400 Valentine Cards, the cover picture of which is reproduced herewith, were sent to women journalists in all parts of the country, with this message inside:—

Sweeter by far than Madame Vestris,
Sweet as *Agaricus Campestris*,
(Whose fungoid joys let no one muffle –
Most glorious cousin to the truffle).
That's saying a lot, so don't decline
To be our dearest Valentine.

Sing we the mushroom's special favours,
Its gentle yet persuading flavours,
Join in our song, and praise the stellar
Virtues of this minute umbrella.
But let this present lay be thine,
Our own, our darling Valentine.

Among the replies received at the MGA office were these two printed on the opposite page:—

CAMBRIDGE MEETING OF MUSHROOM GROWERS

Organised by the Horticultural Secretary of the Cambridgeshire Farmers' Union, Mr. L. Herring, a successful gathering of mushroom growers and others interested in the industry took place at Carpenters' Hall, Cambridge, on Friday evening, 14th February.

Chairman was Mr. C. Hagger, MGA member from Melbourn, Herts., who introduced the two main speakers, Mr. G. W. Baker of Oxted, Surrey, and Mr. Fred. C. Atkins of Yaxley, Peterborough, both members of the MGA Executive Committee.

The twenty minute Esso film, "Mushroom Growing," taken at Mr. Baker's farm at Oxted, Surrey, where the concern is run as the Broadham Produce Co. Ltd., with Mr. A. D. Jones as Mr. Baker's co-director, caused a great deal of interest.

In the discussion which followed, Mr. Baker said he was quite convinced that the operation of the "laundry" at Oxted, in which all bed and side boards were dipped in boiling cresylic acid, was instrumental in ridding the farm of a severe attack of eelworm.

Mr. Atkins, in the course of one of his replies, said, in his opinion, the loss to the industry of Dr. N. H. Pizer (of the NAAS, Cambridge) "was one of the greatest blows the industry has ever sustained."

Thanks to the speakers were expressed by Mr. A. Hawkins of Haddenham, Cambs.

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Without wishing to be a 'kill joy' to fellow-members of the MGA, I should be grateful if you could find space for the following comments in *The Bulletin*.

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ALAN CAMPBELL,
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DON'T FORGET

MGA ANNUAL GENERAL MEETING

TUESDAY, 18th MARCH

at the

CONNAUGHT ROOMS
KINGSWAY, LONDON

Chairman's Reception - noon
Annual Lunch - - 1.15 p.m.
Annual Meeting - - 2.30 p.m.

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